Music Exposure Levels on Campus

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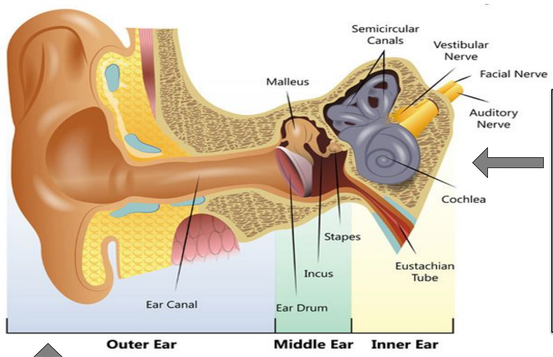
Introduction



The inner ear houses the cochlea which is a snail-shaped, fluid filled organ found in the inner ear that contains hair-like structures that bend in response to different sounds. When bent, the hair cells create electrical signals that are then sent to the central auditory nervous system. When the cochlea is introduced to loud sounds, it can cause permanent damage to these hair cells and can result in hearing loss.

The outer ear starts with the pinna. The pinna is the part of the ear that we see and helps when locating a sound. The ear canal channels sound toward the eardrum. Due to the funneling shape of our ear canal, sound gets a boost in loudness. The last part of the outer ear is the eardrum which is the boundary between the outer and the middle ears. The eardrum is a thin membrane, that consists of layers of skin and fiber tissue. The eardrum seals the middle ear from the environment. Sound vibrates the eardrum and causes the sound to travel to the middle ear.

The middle ear is a hollow space that is separated from the ear canal by the eardrum. The middle ear contains the three smallest bones in the body, the malleus, incus, and stapes, also known together as the ossicles. Sounds travel through the outer ear and are transferred to the inner ear by these bones. The shape and arrangement of the ossicles increases the strength and loudness of the sound. When loud sounds are present, tiny muscles contract and reduce the strength of those sounds. This is thought to help protect the ear from damage due to loud sounds.

A noise dosimeter can be used to assess continuous noise levels and can be used to assess noise levels in varying or intermittent noisy environments (Occupational Noise Exposure, 1998). The noise dosimeter can be used to measure a musician's exposure levels due to the device's ability to examine intermittent as well as continuous noise levels. The noise dosimeter will produce a daily noise dose that is determined by the intensity of the sound as well as the exposure time.

The daily noise dose is expressed as a percentage and is cumulative, and does not decrease over time. This means that a musician cannot eliminate music exposure once it has already occured. A reading of 100% daily dose indicates that the individual wearing the dosimeter has reached the maximum noise exposure for that day.

Study Purpose

Musicians that are in marching and pep bands within a university are exposed to loud music levels and increase their risk of music induced hearing loss (Helleman & Dreschler, 2015). Many of the musicians in a university marching and pep band are young adults, whose developing auditory damage may result in a barrier to effective communication or difficulty hearing in environments that are critical for their current stage in life, which is most likely the university classroom. There is no treatment for music induced hearing loss, therefore education needs to be provided to the population at risk for hearing loss (Harrison, 2012). The purpose of the current study was to measure the intensity levels that the marching band (The 'Pride of Mid-America Marching Band) and pep band (Cardinal Pride Basketball Band) at Ball State University are exposed to during practices to determine if members are at risk for music induced hearing loss, and to present the findings to the School of Music.

Methods

Protocol

- Each volunteer was asked sign the consent form.
- The participant's instrument, location of the practice, and documentation of breaks were written down by the researcher.
- The dosimeter was set to "Normal Mode" which measures and displays noise dose continuously for up to seven days.
- After signing the consent form, the dosimeter was placed on the participant's shirt.
- The data was analyzed and compared the National Institute for Occupational Safety and Health (NIOSH) criteria on daily dose.
- The researcher requested that participants that wore the dosimeter to complete a post survey at the conclusion of the practice.
- An educational presentation was held for the School of Music to discuss results and recommendations.
- The viewers of the educational presentation were asked to fill out a post educational presentation survey.

Participants

- Members of the marching and pep band who where 18 years or older.
- Members from the marching band and pep band that signed the consent form wore a dosimeter during their practice.
- The goal was to obtain 10 different members from each band to wear the dosimeter by the end of the study, totalling to 20 participants.

Data Analysis

- Descriptive statistics were computed to describe the population represented in the study.

Results: Marching Band Noise Dose Recordings and Survey Data

Marching Band

Instrument	Location	Daily Noise Dose
Sousaphone (Tuba)	LaFollette Field (outside)	220%
Piccolo	LaFollette Field (outside)	88%
Claranet	LaFollette Field (outside)	196%
Trumpet	LaFollette Field (outside)	589%
Alto Saxophone	LaFollette Field (outside)	340%
Mellophone	LaFollette Field (outside)	346%
Marching Snare Drum	LaFollette Field (outside)	1960%
Baritone	Music Instruction Building (inside)	469%
Trumpet	LaFollette Field (outside)	69.3%

- The data above was recorded during Fall 2019 for the marching band. All but two participants had a daily noise dose of 100% or over, indicating they have met their daily allowance of noise. One of the trumpet players was exposed to intensity levels that resulted in a noise dose of 589%. This means that the individual has exceeded their weekly allowance of noise exposure in just a two-hour practice period. Two participants that had a noise dose below 100% and could be explained by the limited amount of music exposure due to receiving instruction and number of breaks due to inclement weather.

Instrument	On a scale of 1-10, (1 = silent, 10 = intolerably loud) how loud do you think the music is during practice?	On a scale of 1-10, (1 = not dangerous, 10 = dangerous) how dangerous do you think the music levels are?	Do you experience ringing in your ears before, during, or after any band practice or today's band practice? If so, please describe.	Do you wear hearing protection?	Please list how many hours a week at a rehearsal you wear hearing protection. what ear/hearing protection do you use?
Sousaphone (Tuba); 220%	5	6	Has tinnitus. Ears were ringing before practice, worse after	For loud events, not for band due to not having good tone.	1 hour, foam or etymotic earplugs
Piccolo; 88%	6	4	Sometimes after an indoor rehearsal without plugs, not today through	Only when inside for rehearsal.	2 hours, rubber earplugs
Trumpet; 589%	7	3	no	no	N/A
Alto Saxophone; 340%	7	5	Yes once every two days that lasts a few seconds	No	0
Mellophone; 346%	7	4	Only when indoors	Yes	3-5 , rubber earplugs
Marching Snare Drum; 1960%	8	8	Not often, but some during practice	No	1, has custom earplugs
Baritone; 469%	6	6	When drumline is near	Yes when inside or near drumline	N/A
Trumpet; 69.3%	4	3	no	no	0-2

- The figure above lists the instrument for each person that completed the survey. No participant found that the music levels were intolerably loud, however, the marching snare drummer reported the highest number. This could be explained by examining the daily noise dose which was 1960%, and was the highest noise dose that was recorded for the marching band. Six out of the eight participants that completed the survey reported that they tinnitus, a sign of music induced hearing loss. One person mentioned that they have tinnitus when the drumline is near and could be explained due to the high noise dose that was recorded for the snare drum player, suggesting that those near the drummer also were experiencing the side effects of the high intensity music. Only one person reported that they wear hearing protection for practices 3-5 hours a week. Others reported that they only wear them when they are doing indoor rehearsals or for loud events outside of marching band.

Results: Basketball Pep Band Noise Dose Recordings and Survey Data

Basketball Pep Band

Instrument	Location	Daily Noise Dose
Alto Saxophone	Music Instruction Building 152	2040%
Baritone Saxophone	Music Instruction Building 152	296%
Baritone	Music Instruction Building 152	443%
Mellophone	Music Instruction Building 152	1670%
Drum set	Music Instruction Building 152	2020%

- The figure above shows the data that was recorded in Spring 2020 of the pep band. All participants had a daily noise dose of 100% or over, indicating they all have exceeded their daily allowance of noise. The alto saxophone, mellophone, and drum set player, have been exposed to loud enough music for long enough time that they had over three weeks worth of noise exposure in a two hour practice period. This study found that the alto saxophone player had the highest noise dose of 2040%.

Instrument	On a scale of 1-10, (1 = silent, 10 = intolerably loud) how loud do you think the music is during practice?	On a scale of 1-10, (1 = not dangerous, 10 = dangerous) how dangerous do you think the music levels are?	Do you experience ringing in your ears before, during, or after any band practice or today's band practice? If so, please describe.	Do you wear hearing protection?	Please list how many hours a week at a rehearsal you wear hearing protection. what ear/hearing protection do you use?
Alto Saxophone; 2040%	5	7	Yes during and outside of practice	Sometimes when in small rooms	0; Rubber earplugs when in small rooms
Baritone Saxophone; 296%	6	5	no	yes	2; earplugs
Mellophone; 1670%	9	9	Yes after rehearsal	No	2-3 hours a week if I wear them; rubber earplugs

- The figure above lists the instrument for each person that completed the survey. No participant found that the music levels were intolerably loud, however, the mellophone player reported the highest number. Two out of the three participants that completed the survey reported that they have tinnitus. Only one person reported that they wear hearing protection for approximately two hours a week. Other participants reported that they sometimes use it. The individual that reported that the music was near intolerable and close to being dangerous, does not wear hearing protection.

Conclusions

- Drummers, as well as trumpet players, and those around them during practice were exposed to the highest intensity levels that were recorded.
- Indoor practices produce the highest daily doses.
- Many students are not wearing hearing protection when they should be.
- Nine out of 11 students that completed the survey have tinnitus, which is a sign of damage to the cochlea and can be a sign of music induced hearing loss.
- High fidelity hearing protection devices should be used.
- Further studies should include more practices and more instruments to see if the findings can be replicated

Limitations

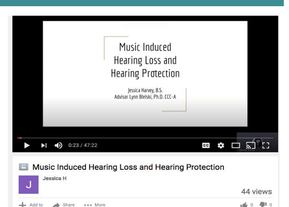
- The researcher was only able to attend 14 practices out of the original goal of 20 practices.
- There was a limited amount of volunteers.
- Some practices were cut short either due to other events the band had planned or due to weather.
- The marching band members were rarely standing in the same place long enough for the researcher to document their formation.

Presentation to The School of Music

- The presentation included a discussion on anatomy and physiology of hearing, current research on music induced hearing loss, the results from this study, how to select hearing protection given the daily dose, and what hearing protection is available to musicians.

The earplugs pictured here are examples of the earplugs the researcher recommended for marching and pep band students due to their low cost compared to other custom musician earplugs.

Students and community members can come to the BSU Audiology Clinic if interested in earplugs!



Screenshot of the 47 minute presentation to the School of Music on YouTube

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Images

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